WHAT IS CLAIMED IS:

Sub A4 1. An echo canceller for use in a transceiver configured to cancel a received echo signal completely in the frequency domain.

2. The echo canceller in claim 1, comprising:

a first matrix of coefficients, and

a second matrix of coefficients,

wherein a combination of a product of the first matrix and a transmitted symbol and a product of the second matrix and a previously transmitted symbol is used to estimate an echo signal.

Sub A4 3. The echo canceller in claim 2, wherein transmitted signals corresponding to the transmitted symbol and the previously-transmitted symbol are real-valued, and wherein the transmitted symbol and the previously-transmitted symbol are divided into real and imaginary parts before being combined with the respective matrix to reduce computational complexity.

4. The echo canceller in claim 2, wherein the coefficients of the first matrix represent how an echo from a currently transmitted frequency domain signal affects a received signal.

5. The echo canceller in claim 4, wherein the coefficients of the second matrix represent how an echo from a previously transmitted frequency domain signal affects the received signal.

6. The echo canceller in claim 2, wherein the coefficients of the first matrix and the second matrix are adapted using a difference between the received signal and the estimated echo signal.

7. The echo canceller in claim 6, wherein the coefficients are adapted using a least mean squares algorithm.

8. The echo canceller in claim 2, wherein the estimated echo signal is removed from the received signal.

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9. The echo canceller in claim 1, wherein the transceiver is a discrete multitone (DMT) transceiver.

10. The echo canceller in claim 2, wherein the first and second matrices are N x N matrices, where N is a number of symbol samples.

11. The echo canceller in claim 1, wherein a vector corresponding to a transmitted frequency domain symbol, a vector corresponding to a received frequency domain signal, and a vector corresponding to an estimate of the echo symbol are all Hermitian symmetric.

12. The echo canceller in claim 1, comprising:

a first vector of coefficients, and

a second matrix of coefficients,

wherein a combination of a product of the first vector and a transmitted symbol and a product of the second matrix and a compensated, previously-transmitted symbol is used to estimate an echo signal.

13. The echo canceller in claim 12, wherein the transmitted symbol and the previously-transmitted symbol are divided into real and imaginary parts before being combined respectively with the first vector and the first matrix to reduce computational complexity.

14. The echo canceller in claim 12, wherein a compensation factor used to compensate the previously-transmitted signal is a complex exponential term.

15. The echo canceller in claim 14, wherein the transceiver is a discrete multitone (DMT) transceiver and the compensation factor compensates for a cyclic prefix associated with the previously-transmitted signal.

16. The echo canceller in claim 1, wherein when a transmitter of the transceiver has a lower sampling rate than a receiver of the transceiver, the echo signal is interpolated at the receiver.

17. The echo canceller in claim 1, wherein when a transmitter of the transceiver has a higher sampling rate than a receiver of the transceiver, the echo signal is decimated at the receiver.

18. An echo canceller for use in an asynchronous transceiver configured to cancel an echo signal, comprising:

a first matrix of coefficients;

a second matrix of coefficients;

wherein a combination of a product of the first matrix and a currently-transmitted symbol and a product of the second matrix and a previously-transmitted symbol is used to estimate an echo signal, and

wherein the estimate of the echo signal is transformed to the time domain and then removed from a received signal in the time domain.

19. An echo canceller for use in an asynchronous transceiver configured to cancel an echo signal, comprising:

a first vector of coefficients;

a second matrix of coefficients,

wherein a combination of a product of the first vector and a currently-transmitted symbol and a product of the second matrix and a compensated, previously-transmitted symbol is used to estimate an echo signal; and

wherein the estimated echo signal is transformed to the time domain and then removed from a received signal in the time domain.

20. An echo canceller for use in a transceiver canceling an echo from a received signal in the frequency domain including circuitry configured to determine an estimate of the echo in the received signal using a frequency domain model of an echo path channel

that includes effects of interference and to subtract the echo estimate from the received signal.

21. The echo canceller in claim 20, wherein the echo canceller is used in a discrete multitone (DMT) type transceiver and the interference includes intersymbol interference and inter-carrier interference.

22. The echo canceller in claim 20, wherein the frequency domain model includes a first set of values that models how an echo from a currently transmitted frequency domain symbol distorts the received signal and a second set of values that models how an echo from a previously transmitted frequency domain symbol distorts the received signal.

23. The echo canceller in claim 22, wherein the first set of values is a first complex matrix and the second set of values is a second complex matrix.

24. The echo canceller in claim 22, wherein the first set of values is a column vector and the second set of values is a matrix.

25. The echo canceller in claim 24, wherein the matrix is combined with a difference between the currently transmitted symbol and a product of the previously transmitted symbol and a compensating factor.

26. The echo canceller in claim 22, wherein the transmitted symbol and the previously transmitted symbol are divided into real and imaginary parts before being combined with the first and second sets of values, respectively.

27. The echo canceller in claim 20, wherein when a transmitter of the transceiver has a lower sampling rate than a receiver of the transceiver, the echo signal is interpolated at the receiver.

28. The echo canceller in claim 20, wherein when a transmitter of the transceiver has a higher sampling rate than a receiver of the transceiver, the echo signal is decimated at the receiver.

29. The echo canceller in claim 20, wherein the transceiver is an asynchronous transceiver where transmitted and received frames or symbols are not aligned in time, and

wherein the echo estimate is transformed into the time domain and then removed in the time domain from the received signal.

30. A frequency domain echo canceller for use in a discrete multitone (DMT) type transceiver canceling an echo from a received signal in the frequency domain including circuitry configured to determine an estimate of the echo in the received signal using a frequency domain model of an echo path channel that includes effects of intersymbol interference and inter-carrier interference and to subtract the echo estimate from the received signal to provide a difference.

31. The echo canceller in claim 30, wherein the frequency domain model includes a first set of values that models completely in the frequency domain how an echo from a currently transmitted frequency domain symbol distorts the received signal and a second set of values that models completely in the frequency domain how an echo from a previously transmitted frequency domain symbol distorts the received signal.

32. The echo canceller in claim 31, wherein transmitted signals corresponding to the currently and previously transmitted frequency domain symbols are real-valued.

33. The echo canceller in claim 32, wherein the currently transmitted symbol, the previously transmitted symbol, the received signal, and the difference are vectors having Hermitian symmetry.

34. The echo canceller in claim 31, wherein the difference is used to adjust the first and second set of values.

35. A method for reducing an echo at a transceiver comprising:

(a) combining in the frequency domain a currently transmitted signal with a first set of values resulting in a first combination;

(b) combining in the frequency domain a previously transmitted symbol with a second set of values resulting in a second combination;

(c) combining the first and second combinations in the frequency domain to estimate the echo; and

(d) using the estimated echo to reduce the echo in a signal received at the transceiver.

36. The method in claim 35, further comprising:
determining a difference between the received signal and the estimated echo, and adjusting the first and second set of values using the difference.

37. The method in claim 35, wherein the first set of values corresponds to a first matrix of coefficients and the second set of values corresponds to a second matrix of coefficients.

38. The method in claim 35, wherein the first set of values corresponds to a column vector of coefficients and the second set of values corresponds to a matrix of coefficients.

39. The method in claim 38, wherein the combining step (b) includes:
multiplying the previously transmitted symbol by a compensation factor to produce a product;
subtracting the product from the currently transmitted symbol; and
combining a result of the subtracting with the matrix.

40. The method in claim 35, wherein when a transmitter of the transceiver has a lower sampling rate than a receiver of the transceiver, the method further comprising:
interpolating the echo signal.

41. The method in claim 35, wherein when a transmitter of the transceiver has a higher sampling rate than a receiver of the transceiver, the method further comprising:
decimating the echo signal.

42. The method in claim 35, wherein a vector corresponding to a transmitted frequency domain symbol, a vector corresponding to a received frequency domain signal, a vector corresponding to an estimate of the echo symbol are Hermitian symmetric.

43. The method in claim 35, further comprising:

dividing the currently transmitted symbol and the previously-transmitted symbol into real and imaginary parts before the combining steps (a) and (b), respectively, to reduce computational complexity.

44. The method according to claim 35, wherein the transceiver is an asynchronous transceiver, the method further comprising:

transforming the estimated echo into the time domain, and

removing the time domain, estimated echo signal from the received signal on a sample-by-sample basis.